Searching for small planets around bright F, G and K star

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Summary and science goals: Many of the current transit surveys aiming to find small planets focus on M dwarf stars. While M dwarfs offer some unique advantages, it is important to search for, characterize and understand exoplanets smaller than Neptune around stars closer in spectral type to our own. We propose to use K2 to carry out a search for transits of small planets around bright F, G and K stars.

Small planets in such systems will be well suited to follow-up with radial velocity in order to determine their masses thanks to the brightness of the host stars. Stars with spectral types from late F to K should have sufficiently low vsini values, but also lower activity levels than M stars, therefore being ideal for RV measurements. They will also be suitable targets for atmospheric studies, and will make up a valuable sample for understanding how the structures, atmospheric compositions and orbital properties of these planets vary as a function of stellar spectral type. Ultimately, these measurements will enable us to constrain the formation and evolution of these planetary systems.

Target selection and expected yield: For our target selection, we began with all stars from the EPIC that fall on silicon during campaigns 4 and 5. We only kept stars with Kepler magnitudes brighter than 12 to ensure the ability to obtain mass determinations for the expected small transiting planets using high resolution spectrographs such as HARPS and HIRES. These systems will also be sufficiently bright to be accessible to current and upcoming space telescopes such as the HST, Spitzer, JWST and CHEOPS. Using a B-V colour cut, we then filtered out stars of types earlier than mid-F (B-V < 0.5) and later than M (B-V > 1.4). We further removed likely giants and subgiants by filtering out stars with proper motions smaller than 4 mas/yr. Our final sample of targets includes 2408 and 2835 stars in campaigns 4 and 5, respectively.

From occurrence studies based on Kepler statistics of small planets around FGK stars, we expect to discover of the order of 100 new small planets during campaigns 4 and 5 as part of this survey.

Methodology: The majority of the targets we propose will be saturated. However, it has been demonstrated on both Kepler and K2 data that high-precision photometry is achievable even for saturated stars by using larger, customized apertures to ensure collection of all the light bled down columns and into adjacent pixels. We will use a similar method to extract photometry for saturated stars. Because centroiding will be difficult for those targets, we will use the pixel position of a nearby star to de-correlate the pixel position from the target photometry, an important step in analysing K2 data.

Relevance to ROSES 2014 and K2 GO - Cycle 1 solicitations: This proposal addresses the following NASA and K2 objectives and motivations: understand how small exoplanets form and determine the incidence of planets able to support life in the Universe. Specifically, this program will provide numerous bright systems hosting small planets amenable to follow-up studies that, together with the K2 data, will place constraints on their formation. It will also assess the composition and diversity of small planets around solar-type stars, thereby contributing to our understanding of how common life is in the Universe.